

UNIT 1 - ENERGY

SECTION 3 - ENERGY CONSERVATION

INSULATION: KEEPING HEAT IN OR OUT

Adapted from: The Alliance to Save Energy

Background Information

Many parts of the country experience large changes in temperature from season to season. But human comfort demands a fairly constant temperature in homes and work places throughout the year. In cold weather, this means preventing heat from escaping to the outdoors. In hot weather, it means preventing heat from entering the building.

Insulation helps maintain human comfort by blocking heat flow. Some materials are more effective insulators than others. The best insulating material for a home will be the one that keeps the most heat in during cold weather and the most heat out during hot weather.

Solar energy collectors also must contain insulation to prevent the collected heat from flowing back into the atmosphere. Hot water tanks and pipes need insulation, too, so that the water they contain doesn't lose its heat.



Materials

- three identical soda cans
- three Celsius thermometers
- a clock, watch, or timer to measure minutes
- a 200-watt incandescent lamp or flood lamp (with reflector and mounted on a ringstand)
- hot water (50-55°C)
- insulating materials: fiberglass, newspaper, wool, aluminum foil, Styrofoam
- rubber bands
- metric ruler
- safety glasses

INSULATION: KEEPING HEAT IN OR OUT**Procedures****Part 1: Keeping Heat In**

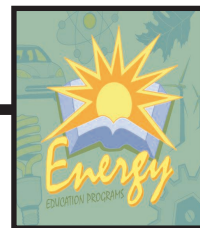
1. Fill the three soda cans to within 1 cm of the top with the with the hot water.
2. Carefully and completely wrap one can with one insulation and a second can with the other. Make sure you wrap the can tops, but leave a small hole above the pop-top opening for the thermometer. (See diagram.) Hold the insulation in place with rubber bands.
3. Leave the third can unwrapped.
4. Wrap rubber bands around the tops of the three thermometers. Insert the thermometers through the insulation and pop-top opening into the cans. Adjust the rubber bands so that the thermometers are at equal depths (about halfway) in the cans and do not touch any part of the cans.
5. Label the first two columns of Data Table 1 with the kinds of insulation you are using.
6. Read and record in Data Table 1 the temperature of the water in each can.
7. Continue to record the water temperature in each can every minute for 20 minutes.
8. On Graph 1, plot your data for each can. Be sure to label each line.



Caution: Do not spill any water on the insulation when wrapping the cans. If you choose fiberglass as the insulation, wear safety glasses and gloves when handling it.

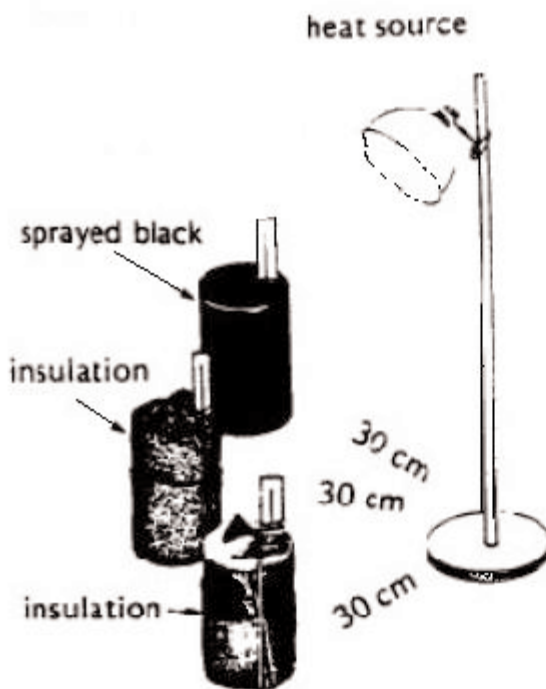
Part 2: Keeping heat out

9. Remove the thermometers and insulations and empty the cans.
10. Replace the same insulations and the thermometers. Position them just as you did in Part 1.



INSULATION: KEEPING HEAT IN OR OUT

11. Place each can the same distance (about 30 cm) from the heat source (the lamp), as shown in the diagram.
12. Label the first two columns of Data Table 2 in the same way as you labeled Data Table 1.
13. Read and record in Data Table 2 the temperature of each can.
14. Turn on the heat source. Record the temperature in each can every minute for 15 minutes.
15. Turn off the heat source. On Graph 2, plot your data for each can. Be sure to label each line.



Caution: Do not look directly at the lamp. Read the thermometers from behind the lamp.

NAME:

CLASS PERIOD:

DATE:

INSULATION: KEEPING HEAT IN OR OUT**Data Table 1
Keeping Heat In**

Time (minutes)	Temperature ($^{\circ}\text{C}$)		
	First Can (Insulating Material: _____)	Second Can (Insulating Material: _____)	Third Can (No Insulating Material)
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

NAME:

CLASS PERIOD:

DATE:



INSULATION: KEEPING HEAT IN OR OUT

Data Table 2
Keeping Heat Out

Time (minutes)	Temperature ($^{\circ}\text{C}$)		
	First Can (Insulating Material: _____)	Second Can (Insulating Material: _____)	Third Can (No Insulating Material)
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

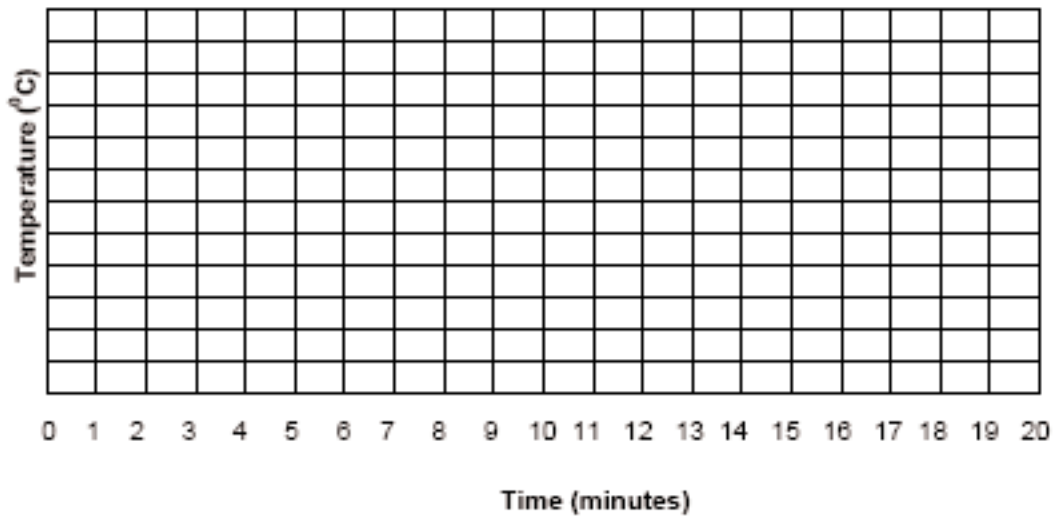
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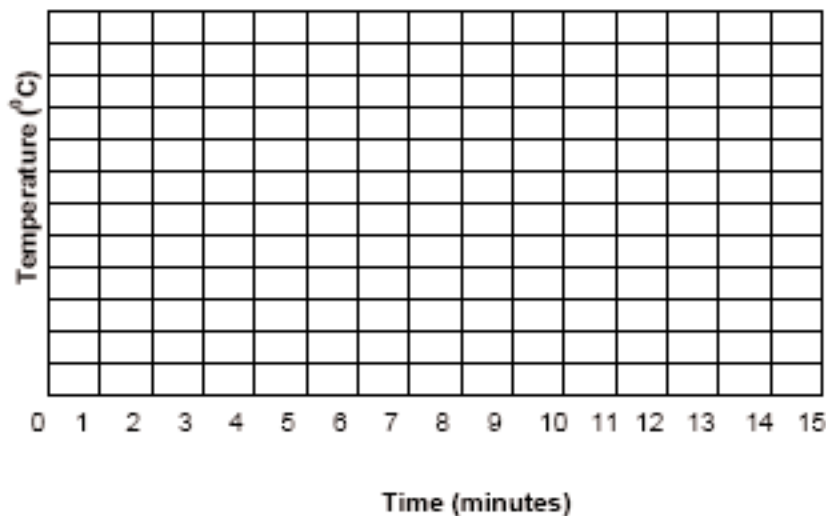
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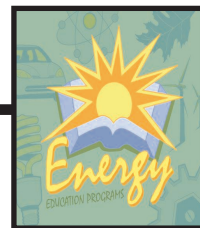
INSULATION: KEEPING HEAT IN OR OUT

Graph 1

Keeping Heat In

Graph 2

Keeping Heat Out



INSULATION: KEEPING HEAT IN OR OUT

Questions

1. What general conclusions can you draw from the graphs? _____

2. What was the total change in temperature for each can in Part 1? _____ In Part 2? _____
3. Why did you use the third can in this activity? _____
4. Of the materials you tested, which was better at keeping heat in? _____
5. Which material was better at keeping heat out? _____
6. Was the same material the better insulator in both cases? _____
7. Based on your results, why do you think insulation is an important part of a solar energy collector? _____
8. Why should a house be insulated to reduce both heat loss and heat gain? _____

Going further

1. Repeat the activity using other sources of heat energy, including the sun. Compare these results to your original results and explain any differences.
2. Find out the R-values of the insulations you tested. Write a paragraph explaining R-values. Then compare your results in this activities to the R-values of the insulations you tested.
3. Visit a lumber yard and insulation contractor to gather information on R-values and costs. Then recommend an insulation based on these factors.
4. Find out the kind, amount, and location of insulation in your home. Determine its R-value. Find out the recommended R-values for walls, ceilings, floors, and basements in your area of the country. If you find your home is not adequately insulated, develop a list of recommendations for improving its insulation.
5. Research how homes are kept cool in summer. List as many ways to prevent heat gain as you can.
6. Hold a "cool cube" contest. Design a container that will keep an ice cube from melting for the longest time.